JPRS 76441

17 September 1980

West Europe Report

SCIENCE AND TECHNOLOGY

No. 32

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WEST EUROPE REPORT

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CONTENTS

ENERGY

EDF BUDGETS 50 MILLION FRANCS FOR ALTERNATE ENERGIES

Paris SCOOP ENERGIE in French 15 Jun 80 p 3

[Article: "EDF and New Energy Sources"]

[Text] EDF [French Electric Power Company] is budgeting more than 50 million francs for new sources of energy in 1980 compared with 30 million francs last year. This announcement was made by M. Magnien, EDF's director of studies and research, on 29 April 1980 during a press briefing on his department's annual report.

EDF is conducting experiments, tests, and research in the following four fields in close cooperation with the CNRS, DGRST [General Delegation for Scientific and Technical Research], BRGM [Bureau of Geological and Mining Exploration and COMES [expansion unknown].

1. Geothermal Power

a. Low energy: A project jointly with the local HLM [Low-cost Housing Program] office in Creil. It involves installing geothermal heating combined with heat pumps for more than 2,000 housing units. This project is expected to produce fuel savings of 60 percent, in other words, more than 1 ton of oil per housing unit per year.

b. High energy: Sinking of four wells at Bouillante [Guadeloupe] where test borings have been made since 1967. These wells currently produce 30 tons of steam per hour at a pressure of 6 bars and 120 tons of water per hour at 160° Centigrade. EDF is going to build an experimental 4,500 kilowatt power plant at the site.

2. Wind Power

The experimental windmill at Nogent le Roi--800 kilowatts, 1958-1963--was followed by the dual experiment at St Remy des Landes--132 kilowatts and 1,000 kilowatts, early 1960's--and then by the windmill at Ouessant on which SCOOP reported in its issue No 28 of 15 November 1979. Other windmills are being planned for the DOM [Overseas Departments]

3. Solar Energy

a. Low temperature Since 1974: research on solar heating and development of heat pumps; bench testing of solar collectors, equipment, and instrumentation at the Les Renardieres test facility; 13 solar houses at Le Havre and Aramon.

b. High temperature

Four years of studies requested by the CNRS culminated in construction of the 2-megawatt Themis power plant at Targassone, Pyrenees Orientales. Construction of this plant is financed jointly by the EDF and COMES. It is scheduled to become operational in 1981.

To promote development of photovoltaic technology, a "club" composed of researchers and manufacturers was recently formed and a joint EDF-CNRS action program has been initiated on this specific subject.

4. Storage of Energy

Continuation of research and experimentation, particularly on hydrogen obtained by electrolysis of water molecules. Among future available alternate sources of energy, hydrogen may well occupy a position comparable to the one solar energy or other renewable forms of energy can be expected to hold.

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PROGRESS IN SOLAR ENERGY REVIEWED AT SYMPOSIUM

Paris AFP SCIENCES in French 19 Jun 80 pp 26-27

[Text] Marseille--Solar powerplants have begun to exist--On 18 June, the organizers of the "International Symposium on Thermodynamic Conversion Systems for Solar Energy." which brought together in Marseille from 15 to 20 June 300 specialists from 23 countries, declared solar power plants have begun to exist.

Making an initial estimate after 2 days of work, Georges Peri, Chief of the Department of Heliophysics of Provence University, observed that the research workers' projects have crossed the thresholds of the laboratories and are now being utilized by industrialists who actually contemplate producing and operating these units.

Albert Strub, chief of the "Research in the Field of Energy" Division of the European Communities Commission has estimated that solar energy will provide 5 to 10 percent of overall energy consumption by the year 2000.

These powerplants are designed to transform the solar energy collected into useful energy for human needs: electricity, heat, mechanical energy. Projects in the process of development aim at adapting the size of these stations to specific human needs which can range from a few kilowatts to 5, 10, 50 even 200 Megawatts, for the proposed pilot solar plant designed by the USSR ministry of Power and Electrification.

Many French programs have been compared with research conducted especially in the United States, the Soviet Union, Japan and in the FRG. Those carried out by CNRS [National Center for Scientific Research] and PIRDES [Interdisciplinary Research Program for the Development of Solar Energy] are paying particular attention to the construction of small and medium power plants (3 Mw to 10 Mw) initially.

These solar powerplants all include a concentration system (heliostats and tower or other types of collectors), a receiver supplying heat to a heat conducting liquid and a heat engine converting heat into mechanical or electrical energy.

The "THEMIS" tower type solar powerplant, on which experiments will last 3 years, will be put into operation at Targassone (Eastern Pyrenees) in February 1981. It will include 200 heliostats of 50 square meters each, a tower 85 meters high, a storage system allowing 4 hours of operation and a 2 Mw turbo-generator. The operation of "Themis" will be the subject of an agreement between COMES [Solar Energy Commissariat], EDF [French Electric [Power] Company] and CNRS.

The "THEK" program envisages the construction of modular collectors which can be grouped in "collection fields" according to the power required. These collectors, which have been the subject of experiments at Saint-Chamas (Bouches du Rhone) and whose construction will begin at the end of 1980, will be installed at the end of 1981 in four locations. One particularly will be used to test a steam production system, another will be included in a plant in the agro-food branch, a third will be used as an auxiliary in the "Themis" powerplant in Targassone. COMES has taken charge of this progam.

The "Sirocco" project, a variation of "THEMIS" plans to substitute a turbine heated with gas for the steam engine which, at the top of the tower, converts the heat received into electricity. The solar energy laboratory in Poitiers (CNRS), which is in charge of this project, thinks it can thus considerably improve the efficiency of the "THEMIS". The experiments on this project will begin in September 1981, with the collaboration of the AEC [Atomic Energy Commission], at the Odeillo (Eastern Pyrenees) solar furnace.

Finally the "Pericles" powerplant project (production of energy in isolated areas through the limited concentration of solar energy), of which a prototype with a thermal power of 50 Kw exists in Marseille, is especially designed to assure electric power production in the villages or agricultural operations not connected with the system and also for the production of thermal power for local industries (refrigerated warehouses, canneries, sawmills).

Experiments, beginning in 1981, with these types of programs, according to the organizers of the Marseille symposium, should allow rapidly implementing the construction of heliothermal power plants "made to measure," making it possible to replace a considerable part of the conventional energy (coal, oil, hydraulic power).

8490
CSO: 3102

TELEFUNKEN PROPOSES WORLDWIDE PLAN FOR SOLAR HYDROGEN

Paris AFP SCIENCES in French 26 Jun 80 pp 27-28

[Article: "Solar Energy Can Meet World's Energy Needs"]

[Text] On 20 June, Telefunken, a German firm, proposed a 50 trillion dollar plan designed to meet the world's energy needs through solar energy.

This plan would be implemented between now and the mid-21st century. It is outlined in a study published under the signature of Rheinhard Dahlberg, manager of Telefunken's semiconductor division.

The plan calls for the installation of multiple immense units capturing solar energy by means of photovoltaic cells. These units would be installed in tropical and subtropical regions over a land area equivalent to that of Saudi Arabia.

The electricity thus produced would be used to produce hydrogen from seawater. This hydrogen would then be distributed as fuel by a worldwide network of gas pipelines and special ships.

The cost of hydrogen obtained by this process would be "comparable to the current cost of gasoline."

The study, entitled "Replacement of Fossil Fuels by Hydrogen," states that reserves of "cheap petroleum" will be depleted by the year 2030 and coal reserves by the year 2075 if coal is used for the production of synthetic fuels. Hence the necessity of moving toward hydrogen.

In Dahlberg's view, production of hydrogen from solar energy will no doubt be easier and less expensive than from nulcear fission or fusion.

Under this program, by the year 2040, the world could be annually producing from the sun quantities of hydrogen equivalent to 100 billion barrels of oil.

In 1979, world oil production totaled 24 billion barrels. Dahlberg acknowledges that the obstacle to the use of solar energy at the present time is the continuing very high cost of photovoltaic cells. But their cost is expected to drop considerably within the next few years. For example, Telefunken researchers are endeavoring to lower the price per watt from its current 30 dollars to 30 cents by 1985.

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GASIFICATION COMBINED CYCLE POWER PLANT PLANNED

Stockholm NY TEKNIK in Swedish 12 Jun 80 p 3

[Article by Per Stenson: "Methanol Gasoline as Early as in 1984"]

[Text] According to Harald Haegermark we should be able to introduce methanol as a motor fuel in Sweden in the fall of 1984. Hagermark is secretary of the fuel group of the oil substitute committee.

Sweden should primarily rely upon M 15, a mixture of gasoline and 15 percent methanol.

According to the Oil Substitute Committee an annual consumption of 18,000 m^3 of methanol would be an appropriate start. This became apparent in an IVA [expansion unknown] symposium last week.

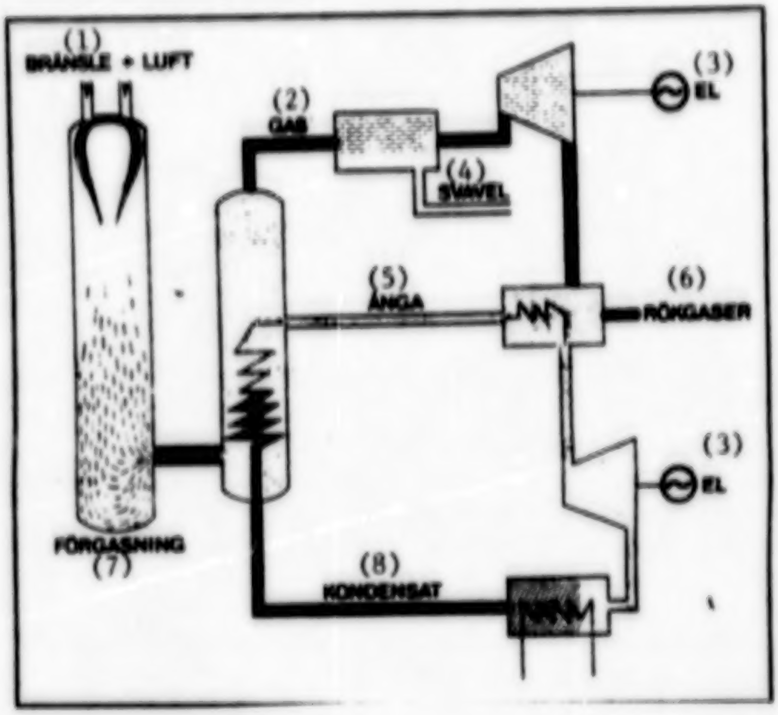
Sweden has no resources for producing such quantities of methanol. However, Kema-Nobel plans to build a methanol plant in the Netherlands together with Norwegian interests. Kema-Nobel today holds 5 percent of the stock in a Dutch plant that produces methanol.

The Norwegians have large deposits of natural gas for which there are at the present time no buyers, and the gas is stored underground.

When storage capacity is exhausted around 1985 the Norwegians will probably build one or more methanol plants in Bergen.

At present M 15 can be obtained at 4 service stations in Sweden. Within a short time the number will increase to 17.

The Riksdag should be able to make a decision on M 15 in the spring of 1981.



Key:

1. Fuel and air
2. Gas
3. Electricity
4. Sulphur
5. Steam
6. Smoke
7. Gasification
8. Condensate

[Caption]

How the new process functions:

Waste oil from refineries is gasified together with air. Coal can also be used. The result is a low-value combustible gas consisting of hydrogen, carbonic oxide and nitrogen. The gas is burned, driving a gas turbine. Impurities, primarily sulphur, nitrous oxides and heavy metals, are removed from the process prior to the combustion.

Surplus heat from the process drives a steam turbine. In this way a combination power plant with high heat recovery is obtained. The gas turbine effect is 90 MW, and the surplus heat produces 70 MW in the steam turbine.

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UNDERGROUND COAL GASIFICATION STUDIES YIELD RESULTS

Paris AFP SCIENCES in French 5 Jun 80 p 28

[Text] Paris--Coal gasification: Success of the experiment at Bruay in Artois. GEGS [Study Group on Underground Gasification] announced on 29 May that a first stage of great importance in the research conducted at Bruay in Artois on deep underground coal gasification has just been successfully completed.

GEGS which has been conducting research since September 1979 at Bruay in Artois at the northern coal mines (Strait of Dover), includes BPGM [Bureau of Beological and Mining Research], CDF [French Coal Mining Company], GDF [French Gas Company] and IFP [French Petroleum Institute].

The aim of the experiment is to develop a technique for burning coal at great depths and obtaining natural gas in exchange. In order to burn the coal, it is necessary to break the rock, so that the oxygen injected through a bore hole can circulate in the coal vein, thus allowing combustion and extracting gas through a second bore hole made further on in the same coal ein.

It is precisely this fracturing through high pressure water injection which GEGS has just succeeded in at Bruay in Artois, thus effecting a connection between the two bore holes 60 meters apart and carried out from a mine level 1,000 feet deep.

The French Coal Company declares that the research conducted in France on gasification at great depths is unparalleled in the world. Experiments at slight depths have been undertaken in other countries, but have their drawbacks. In fact, they declare that when the depth is not sufficient, there is a possible risk of water infiltration, possible pollution of underground water and surface disturbances. On the other hand, work at greater depths provides more guarantee of being watertight.

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CSO: 3102

CREUSOT-LOIRE TO BUILD COAL GASIFICATION PLANTS

Paris AFP SCIENCES in French 26 Jun 80 p 28

[Article: "Creusot-Loire Plans To Build Two Coal Gasification Plants"]

[Text] The French Creusot-Loire industrial group intends to begin operating two coal gasification plants in 1985. One is to be at Le Havre, the other at Feyzin near Lyon. Each plant will have an annual production capacity of 500 million cubic meters of gas. These plans were announced on 25 June by Roger Dumon, Creusot-Loire's research director.

This project is currently under study. Dumon explained that the construction cost of each plant would be 1.5 billion francs, a sum approximately equivalent to the cost of building a nuclear power plant.

As of 1981, a pilot facility, now in the design stage, would have a production capacity equivalent to 15 tons of coal (1,200 tons per day for the plant). Construction cost of this pilot facility is some 80 million francs, half of which Creusot-Loire hopes to finance by itself, with the remaining cost being shared by the French Gas Company (GDF) and probably some French oil companies.

Creusot-Loire's gasification process employs a method developed by Texaco, an American corporation. The process can use any kind of coal without polluting effluents. This easily exportable process is a first stage toward obtaining an energy source which, according to Dumon, could between now and the end of this century represent for Creusot-Loire half the business volume of its nuclear-related operations.

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RESEARCH ON COAL GASIFICATION PROGRESSES

Paris AFP SCIENCES in French 10 Jul 80 p 20

[Article: "New Steps in Coal Gasification"]

[Text] Progress is being made in coal gasification research. The Underground Gasification Study Group (GEGS) has announced successful completion of the second phase of its experiments at Bruay en Artois. In addition, a new study group on coal conversion by hydrogenation was formed recently.

In a press release, the GEGS, whose membership consists of representatives of the Bureau of Geological and Mining Exploration (BRGM), the French National Coal Board (CDF), the French Gas Company (GDF), and the French Petroleum Institute (IFP), revealed it was continuing its research on the first French deep underground gasification pilot plant at Bruay.

After digging two wells and successfully completing the passage between them, the coal at the bottom of one well has been ignited by means of a device installed by the GEGS. Propagation of this fire is now underway. This propagation is necessary before being able to move on to subsequent phases.

The agreement calling for formation of a Cool Hydrogenation Study Group (GECH) was recently signed by the GDF, CDF, IFP, and National Center for Scientific Research (CNRS).

This study group's objective is coal gasification aboveground by a process which consists in treating coal with hydrogen so that it becomes liquid, and then hydrogenating the liquid products thus obtained.

The GECH plans to develop a valid process between now and 1983, and then make its technical and economic evalution of the process. Costs of this research are jointly financed as follows: 50 percent by GDF, 30 percent by CDF, and 20 percent by IFP. The CNRS contribution will amount to 15 percent of the expenses incurred by the other parties.

The estimated overall cost of the operation is approximately 70 million francs. Financial assistance has been requested from the General Delegation for Scientific and Technical Research (DGRST) and the European Community Commission. The GDF and CDF will make available to the study group the findings of studies conducted under earlier coal gasification programs.

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CSO: 3102

NEW STEEL PROCESS YIELDS USABLE GAS AS BYPRODUCT

Stockholm NY TEKNIK in Swedish 19 Jun 80 p 12

[Article by Tina Lundh: "Cleaner Steel and Combustible Gas From New Process"]

> [Text] Gasification of coal during steel production is possible using the technique of injection. This method has attracted wide attention within the steel industry. In addition, the technique of injection gives a valuable gas, and also lower production costs. The gas can be used in combined power and heating plants, and as a reducing agent in the metallurgical industry.

The technique of injection in the production of steel is used today for sulfur and phosphorus cleansing and for addition. In his doctoral thesis, "The Study of the Reaction With the Injection of Iron Ore, Coal and Oxygen in Melted Iron," mining engineer Olle Wijk reports the possibilities of the injection technique. At the Institution for Technical Processes he has studied and tested a process combining the production of steel with the gasification of coal.

When the iron ore (iron oxide), powdered coal and oxygen are injected into a bath of melted iron, a local zone is created in the bath. All the chemical reaction takes place in the zone. The injection gives a powerful stirring effect and the injected material is carried to the surface of the iron bath.

Gas Mixture

In the local zone oxygen is freed from the iron and is combined instead with coal. The result is a mixture of gas consisting of carbon monoxide and hydrogen. Simultaneously, the sulfur and phosphorus are combined creating a layer of slag. Sulfur and phosphorus are pollution in steel.

The gas mixture which is extracted is considered clean and good gas. It can be used in combined power and heating plants. Compared with many high sulfur fuels this gas is almost free of sulfur.

The megallurgical industry is also interested in the gas. That industry can use it as a reducing agent.

On the other hand it is not realistic to use the gas to produce methyl alcohol. It is too expensive.

Phosphorus Cleansing

Olle Wijk has tested the coal gasification process in a 6-ton test oven at Uddeholm in Hagfors and at the metallurgical research station in Lulea. The results were positive, and tests will now be made on a large scale in private industry.

The steel industry is greatly interested. The technique of injection makes it possible to shorten production time, and results have been achieved that could not be attained with smelting. One reason is phosphorus cleansing. Iron ore from Norrbotten has a high phosphorus content which must be reduced.

Results at the Technical University in Stockholm have already had an important effect in Japan. The steel producer Sumitomo Metal Industries is spending $6.3 million on coal gasification techniques. The company hopes that the gas can reduce their dependence on oil for steel production.

In his dissertation Olle Wijk also studied the possibility of direct production of steel, omitting the two steps of concentration and sintering. Today it is not attractive, because the process requires electrical energy, and is therefore expensive.

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CSO: 3102

SELF TEACHING ROBOTS NEAR REALITY

Stockholm TEKNIK I TIDEN in Swedish No 2, 1980 pp 14-15

[Text] A robot which cannot only "see" but can also teach itself may be a reality in a few years. Assistant Professor Gosta Granlund and his colleagues at the Technical University in Linkoping have in recent years developed a new technique of optical image processing which probably represents a great leap forward in that field. And not only that, the robot can be taught to search for objects on its own, such as cancer cells, and do it with increasing accuracy. Doctor Robot is on his way.

Assistant Professor Granlund can proudly confirm that no other research group has yet had such results. Neither in Sweden nor abroad. He said, "The consequences of this development are really enormous. The robot can be an obedient slave which can make great contributions, primarily in medicine and automation in industry."

Robots which "see" are being developed today throughout the industrial world. Examples of these and the ideas behind them are presented in this issue of TEKNIK I TIDEN. They are the results of developments in optical image processing during the last 20 years.

Information

Assistant Professor Granlund--and other scientists--claim, however, that the techniques which have previously been developed are too coarse. A picture is taken in black and white with a TV camera, for example, eliminating all the gray tones, "noisy" edges and the like, and the result is a rather small number of sharp lines and contours remaining. Using these a robot can be guided by means of a computer.

"If more of the information can be retained and utilized, considerably more value can be obtained from the picture," said Gosta Granlund. "This technique is necessary so that we will be able to solve the relevant problems in optical image processing by the end of the 1980's, and that is what we are in the process of doing."

The Basic Ideas

Granlund brought forth the basic ideas several years ago when he was working at MIT (the famous technical university in Boston). At that time he began to study optical sensing in earnest in order to utilize some of its features in optical image processing techniques.

The basic ideas can be summarized here:

In an ordinary photographic image there is too much information for a normal computer to process in a reasonably short time. Much information must be removed, but such features as color, gray tones, weak outlines and the texture (structure) of the surface should remain.

If such an expanded program is to be successful it is necessary to describe each picture in local one-dimensional terms ("The details are wiped out in a small window").

In such a picture the changes in gray tones or colors can be registered. It is most important to be able to detect the size and direction of edges and outlines. Directional information in structures is very important. It must be integrated into the processing of the picture.

"Boundary lines of different kinds are very important for the functioning of the eye," said Granlund. "We could get along in a world without colors, because the gray tones would suffice, but never in a world without outlines."

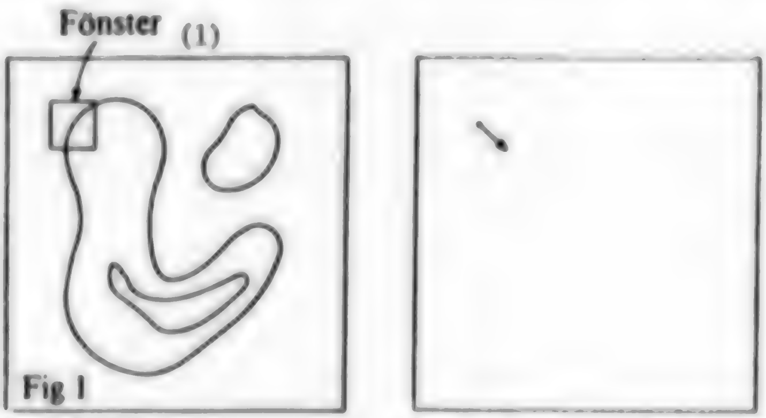
It is the same for a "seeing" robot.

Technically speaking, the process is approximately as follows:

A picture is taken in black and white or color of an object which is to be studied by using, for example, a TV camera. This gives the light intensity value of all the points in the picture.

The values are transmitted to a processor where they are treated by one or more sensors which register different things in the picture. The data is presented in the form of vectors. Figure 1.

Figure 1.



Key:
1) Window

Fig 2

Figure 2

The contrasts passing through the window in the picture are depicted in the form of vectors as shown in the diagram on the right. The vectors for a circle can look like those in Figure 2.

If it is desired to portray what is happening, the angle of the vector can determine the color of the surface, while its length indicates the brightness of the light (color intensity).

Vectors

The sensor consists of an edge and a line detector which reads the picture and indicates variations in its passage between, for example, lighter and darker parts.

The value of the vectors derived can later, with the aid of the sensors, be treated in basically the same way, surface by surface (Figures 2 and 3). Vectors in, for example, an evenly gray area or an area without structure cancel each other out. The sum is zero. That is information which is not needed.

If the picture is inspected through a little "window" much detailed information is obtained. With a larger inspection surface less detail of a structure can be determined, but on the other hand there is less disturbance caused by noise in the picture (Figure 3).

Figure 3 shows the vectors for a portion of a picture (first transformation). If the picture is studied again in the same way, the second transformation is obtained, which is the result of the vectors in the upper picture. This then indicates the maximum contrasts in the picture.

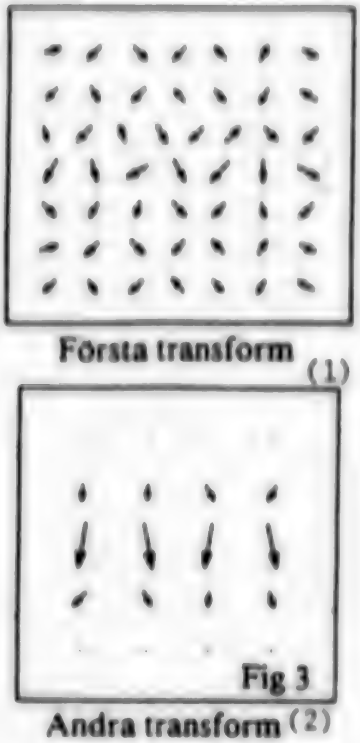


Figure 3

Key:
1. First transformation
2. Second transformation

In Figure 4 there is an imaginary border line (a) which is observed by two sensors, and the curves which they create (b and c). If the data processor combines both curves the result will be a curve which has partly eliminated nonessential information and at the same time gives essential information in a distinct way. Several similar operations can be employed, but two or three "window operations" are normal.

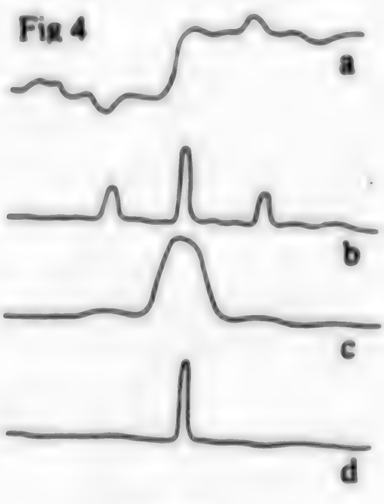


Figure 4

In Figure 4 (a) is the outline which is to be detected. (b) and (c) are the outlines which different sensors provide. Combining these gives outline (d) which has been cleared of unnecessary information but retains that which is important.

Self-Teaching

One consequence of this technique is that Granlund, by repeating his process, can work out vectors time after time, deriving values which more and more precisely indicate the important gray and color variations in a structure or a picture. He can derive variations on variations on variations. The information in a picture exists precisely in the non-random variations of different properties.

This makes it possible to teach the computer-robot to teach itself more.

If, for example, the original picture is inspected by a smaller sensor, which then transmits it to the next (less detailed) sensor (second transformation), after that a feedback process (Figure 5) can be initiated back to the first sensor again. This can then be programmed so that it searches more accurately for certain details in the picture. Its information is therefore acquired from a higher level where there is a better understanding of what can be expected from the picture.

In Figure 5, by arranging a feedback after the second transformation, the information that has been determined in the picture is fed back to the first transformation, giving the computer robot the capability of learning from experience.

The longer the system operates the better the computer robot can look for desired details in the original picture. It teaches itself to search with increasing accuracy.

In practice this means that one can study and extract, bit by bit, even blurred outlines (electronics technicians call them noisy outlines), something which is very often of great importance, for example when cancer cells are being examined, or uneven surfaces.

The result can be presented in color pictures of the type seen on this page.

Searching Out

Another and perhaps even more important consequence of this technique is that the robot can be taught to search for certain objects in a picture. The robot is taught by pointing out the object which it shall select, for example, cancer cells and normal cells, and shown which is which. The robot can then search for the characteristic properties in sick cells, and then itself decide if a cell is sick or normal.

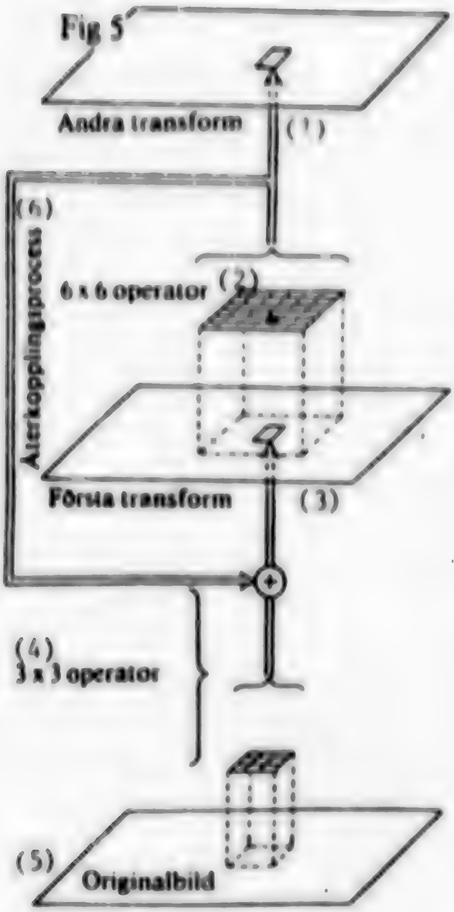


Figure 5

Key:

1. Second transformation
2. 6 X 6 sensor
3. First transformation
4. 3 X 3 sensor
5. O-iginal picture
6. Feed-back process

The robot can also follow up its own work and find other properties which make the sorting process easier and more exact. In this way it can learn from its own experiences.

Moving Pictures

A normal computer does not have the capacity to carry out needed optical image processing. The computer which Granlund developed and which he calls the GOP--General Operating Processor--increases the processing capacity by 300 to 1,000 times.

In the future it is entirely possible that the speed will be greatly increased, and that moving pictures can be processed.

Information About 'Doctor Robot'

GOP--General Operating Processor--opens up a number of applications which it has not been possible to investigate previously in the field of optical image processing. It opens up the entire area of complicated pictures with low contrast in a range of grays and in color.

Tissue Investigations

In the market there are very large areas. One of the largest is tissue investigation of test animals by pharmaceutical firms. The toxicity of new drugs is tested on animals and the changes which take place in the tissue can be investigated. These investigations are very time consuming.

A very important special case is tissue investigation of the foetus or embryo of test animals to examine birth defects. In this area it is desirable to increase the number of tests.

Also tissue examinations of people--for example in cases of suspected cancer--are widespread.

All these are areas which can advantageously be worked on with the GOP when the cells can be detected by color, weak outlines, and variations in texture.

Analysis of CT X-rays

The technique for CT (computed tomography) X-rays has in a short time revolutionized the X-ray diagnostic field, and gave last year's Nobel Prize for medicine to the area of optical image processing. Together with Prof Paul Edholm at the Regional Hospital in Linkoping there is a cooperative project for a new method of computed tomography, called ectomography.

The CT procedure is the source of pictures which should be capable of automatic interpretation. They show a slice through the body and are consequently relatively simple. So here we have outlines which are relatively diffuse and the powerful procedures of GOP are needed to accomplish discrimination.

This automated analysis of CT X-rays is regarded as a very relevant problem. The number of such pictures is increasing rapidly.

Typical problems are to determine the size and location of different organs and to see if they are normal. It is also desirable to be able to take several samples and collect information from these about a certain organ, and perhaps build a three-dimensional picture of the actual organ. The GOP process lends itself very well to such operations.

Quality Control

There are techniques which exist today in this area which are based on optical image processing. There are, however, only a few problems which can be solved with today's technique. When it comes to a decision whether the surface quality of a product is suitable, more advanced methods must be utilized. In data technology a developed technique is needed for example in certain types of inspection. Here the GOP can have an important market, especially if it can teach itself what it is to detect.

Also, in the inspection of machine parts, an advanced technique such as the GOP can certainly be utilized.

Industrial Robots

One area where a major use of optical image processing is anticipated in the future is for sensors for industrial robots. Certain progress has been made in the use of existing techniques. They are, however, limited to relatively simple situations and pictures, mostly of the usual silhouette type.

By using the GOP a wider area of utilization can be achieved with optical information in a range of grays and colors. Another important property in that connection is that the GOP can be made to give stereoscopic (three dimensional) information which is a very unusual property for a picture processor.

Stereoscopic information is of great importance for industrial robots. This will enable them to make distance judgments based on picture information.

Satellite Pictures

These can advantageously be processed in the GOP, which can handle up to 16 colors. Here a significantly higher reliability in classification can be attained because of the GOP color sensitivity and the ability to detect structures in the pictures.

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SCIENCE POLICY

EEC WORKS FOR WORLD ENERGY COOPERATION

Paris L'INDUSTRIE DU PETROLE GAZ-CHIMIE in French May 80 pp 39-49

[Article by Eric Meyer]

[Text] In the effort the European Community is making to help the countries of the Third World to develop the different sectors of their economy--agriculture, industry, trade, etc.--a new field of action has come to be added, one which is taking a more and more important place: that of energy.

In 1975 in Paris energy had a major place on the agenda of the North-South Dialog, which brought together at the same table the representatives of 27 countries or organizations of the industrialized and developing worlds, in order to search for agreement on common economic problems.

Energy was also one of the major subjects of negotiation between the EEC and the 57 countries of Africa, the Caribbean, and the Pacific (ACP), during preparation of the second Lome Convention (concluded 31 October 1979). It should be at the heart of discussions when the North-South Dialog is resumed in New York in November 1980. In a word: there is no longer any international negotiation where energy is not part of the picture, at least in spirit.

Energy cooperation is not limited to diplomatic discussions, however necessary they may be: Europe, which had contributed to projects in stock-taking, equipment, or exploration in several ACP countries, in the framework of Lome I, is getting ready to furnish much more substantial assistance to the associated countries and, more generally, to all

developing countries (LDC's). The participation of other industrialized states and international organizations will be essential for success: in this sense, the outcome of the next North-South Dialog could be decisive.

Why Energy Cooperation?

The recent emergence of energy cooperation, and the very lively interest it has aroused in Europe and the Third World, can be explained in two complementary ways: growing interdependence, and the energy crisis.

Interdependence is one of the key words of European development policy; the Lome Convention, for example, looks toward the strengthening of economic interdependence among the Nine and the ACP countries. In 1970, Europe imported goods worth some 12.3 G$ from the non-oil-producting LDC's, which purchased goods worth 11.3 G$. In 1978, this trade had risen to 42.2 G$ for the Community and 44.4 G$ for the non-oil producing LDC's: it thus more than tripled in less than 10 years.

Economic interdependence has grown in a still more spectacular way between the Community and the OPEC countries, which bought, in 1970, $3.8 G$ of products from the Nine compared to European imports amounting to 9.1 G$. In 1978, these figures had gone up respectively to 39.4 and 48.2 G$. In other terms, the OPEC countries absorbed, in 1978, 17.9 percent of all European exports, against only 8.2 percent in 1973. Interdependence means, for Europe, providing for the majority of its energy and raw materials needs, and for the LDC's transfers of foreign exchange and technology' on the worldwide scale, it is responsible for large changes in capital and product flows, and produces a picture which is both more complex and less inequitable of today's global economy.

The energy crisis should have served to reveal the poorly adapted state of consumption patterns and supply flows of the oil-consuming countries.

Confronted with the quadrupling of prices in 1973, the United States believed it could meet the challenge of OPEC with a "consumers' club," and founded the International Energy Agency. In Europe, on the other hand, we reflected on the posiibilities of coöperation and dialog with the energy-producing countries: from this preoccupation was to be born the Euro-Arab dialog and the North-South dialog. Today, in 1980, the American and European positions have moved much closer, thanks to a better understanding of the "energy inventory" on a global scale.

As a matter of fact, in 1978, humanity consumed 6.3 Gtep; in the year 2000, this consumption should be between 12 and 20 Gtep. Various studies set the date for exhaustion of our oil reserves between 2000 and 2010. As to the price of oil, it has gone from $1.80 per barrel in 1970 to 18.50, indeed to $23.50 per barrel on 1 July 1979: these three facts give a good picture of the world energy problem.

The new conditions of access to black gold may be supportable by the industrialized countries, but they weigh dramatically on the budgets and thus on the growth of the LDC's. In 1978, the United States had 7.8 M/tep per person and Europe 3.1 tep, while each citizen of the LDC's had only 0.3 tep, sometimes much less (0.008 tep in Burundi). Claude Cheysson, European Commissioner of Development, expressed this situation, writing in 1978: "The era of cheap energy has ended, before most people could benefit from it...the real crisis is yet to come."

Almost all countries in the world recognize at present the necessity in the medium term of moving to other sources of energy (nuclear or renewable) and of holding back oil for transformation into other chemicals. The Community is no exception, but it believes this cannot be done except through cooperation with the LDC's, in order to lighten their common dependence on oil. The ACP countries, for example, have potentially rich sources of energy still unexploited for lack of expertise, capital, and technology: Europe has all of those.

Supply and Demand in Europe and the ACP Countries

In 1978, the Community consumed about 930 Mtep of which 530 was in oil, this being a dependency factor of 51.6 percent. In the year 2000, its demand should have risen to about 2 Gtep or 5.4 tep per person. In 1975, the ACP countries consumed 25 Mtep or 0.085 tep per person; to this figure must be added the energy sources unique to the LDC's, known as "noncommercial": wood, peat, dried excrement (about 200 kg per person). With small exceptions, the ACP countries are only familiar with oil: they all are consumers, and 37 of them are at a dependency level higher than 90 percent.

Compared to the needs and possibilities of the ACP countries, the resources of the Nine are modest: coal (losing ground: 245 Mt predicted for 1980), natural gas from the Netherlands and Britain (89 billion cubic feet of reserves), and French uranium (2,850 tons estimated in 1980, 4,500 tons in the year 2000).

The ACP's hold 22 Gb of oil, mostly situated in Nigeria; these reserves could be increased in the future by more discoveries. Nigeria still has 42 billion cubic feet of natural gas (but the other LDC's, especially those in OPEC, have 41 percent of world reserves). Three ACP countries are uranium producers: Niger (9,000 tons), Gabon (1,000 tons), and the Central African Republic (1,000 tons). These holdings are interesting to Europe because all the other non-communist producers (United States, Canada, Australia, and South Africa) make up a de facto cartel, which only agrees to sell uranium that is enriched, and on economic and political terms undesirable for the member states.

There remains renewable energy, which will probably be the energy of the future for the LDC's: sun, rain and wind in the ACP countries offer ideal

conditions for experimenting with new energy installations, and are often feasible right now. In the already well-charted domain of hydro-electric potential, the Third World holds 66 percent of the planet's potential, including 26 percent in Africa alone, and 14 percent in Zaire. The huge Inga dam on the Zaire river will have a capacity 20 percent greater than the electricity consumption of the FRG in 1978. But with their thin populations dispersed over large areas, the ACP countries perhaps have still greater need for micro-projects to supply the needs of villages: micro-hydraulics, wind-generators, the photo-voltaic pump, are all means of reducing the dependence of the ACP countries on oil.

But What is the Community, and What is the World, Doing?

The big suppliers of energy development assistance amount only to a half-dozen countries, groups of countries, or international organizations. Altogether they are going to invest 2.47 billion EEC accounting units in 1980: a total barely higher than that for 1979: 2.31 billion EEC accounting units. The World Bank (IBRD) is by far the largest purveyor of capital: nearly two-thirds of all outlays for energy cooperation the UNDP (United Nations Development Program) has a very limited budget: 14 million EEC accounting units, almost equal to that of Japan (13 million EEC accounting units). The United States' participation is equally modest: 47 million EEC accounting units (it provided 180 the year before). The OPEC special fund, for its part, will devote 55 million EEC accounting units this year to energy cooperation.

With 703 million EEC accounting units estimated in 1980, the Community seems to be the second-biggest global partner of the LDC's in terms of energy development. It is even the biggest--and by far--in terms of supplying non-reimburseable outlays (50 percent of its assistance). It is a remarkable fact that the commitment of the member states is 3 times larger than that of the Community; however the growth of Community participation is much more rapid--it almost doubled this year.

All these cooperative initiatives have their different budgets, configurations, and objectives.

Thus, the World Bank provides only loans, the great majority of them destined to the generation of electricity, but also more and more to oil and coal. The UNDP confines its activity to technical assistance, in the area of training and energy programming. Three-fourths of this aid will be divided in 1980 in equal parts between fossil fuels (oil and coal) and new sources of energy. The American effort is almost equally divided between technical and financial assistance, on the one hand, and electrification and new energy fources, on the other. OPEC loans out, especially in Asian countries funds for construction of electricity generating plants (water- or coal-powered).

In general, the aid from all these organizations and countries is fairly well distributed among the various regions of the developing world:

Latin America, Africa, southern Europe, with perhaps some priority emphasis on Asia.

We have already seen that participation by member states is greater than that by the Community as such. Curiously, this bilateral aid is far from giving special treatment to the African continent, as the Community does with the Lome Convention: the other world regions are at least as well treated. This is in part due to the fact that the FRG, a large purveyor of development aid, has no colonial history and can thus involve itself anywhere in the world, which balances European assistance among the various continents.

Overall, the Community's technical assistance to the LDC's in the energy field is by a great margin the biggest in the world (half of all allocations, close to 50 percent since last year). It is divided into "boxes" in equal parts: electricity, renewable energy, and research and development; benefitting, especially, as we said, Asia and South America (Africa gets 23 percent).

Financial assistance is especially targeted on projects for production of electricity (82 percent of 1979 grants, 64 percent in 1980), but renewable energy is also becoming more important: 40 million EEC accounting units in 1980. There again, Asia and southern Europe (Portugal, Turkey) receive more aid than Africa.

The Community as such also enters in, outside of Black Africa, through the framework of preferential agreements already existing with certain countries in the Mediterranean basin. For example, the European Investment Bank [EIB] has just loaned 10 million EEC accounting units to Lebanon for expansion of the Jieh electrical generating plant.

This cooperation with the associated LDC's is not insignificant; in terms of investment it is certainly greater than what is offered the ACP countries. In 1980, the Community envisions giving close to 7 million European accounting units to the ACP countries and loaning them 25 million; in the same period, European countries will get close to 3 million EEC accounting units, and will get loans of 150 million!

The EEC moreover regularly participates in projects in the non-associated LDC's: since 1978, it has been working with the Latin American Organization for Energy Development (OLADE) to establish an inventory of geo-thermal resources in Haiti, the Dominican Republic, and Peru; the same year it furnished 4.8 million EEC accounting units toward construction of a dam (Tarbela) in Pakistan, financed by the World Bank, the United States, and 3 member states.

The Lome Convention

But the Lome Convention remains the basic element in the Community's energy cooperation, by reason of its breadth and the diversity of its resources (see box below). The first convention (1976-1980) only broached the subject of energy in passing: the term was mentioned three times, in Title III (industrial cooperation), Title IV (financial and technical cooperation), and in the second protocol (financial and technical cooperation). These articles provided that any energy project from the ACP countries could be financed--or co-financed--by subsidies from the European Development Fund (FED) or by loans from the EIB, with the exception of investments in the oil sector, for which the BEI could not provide loans at the concessional rate of 3 percent. On this basis, a certain number of actions were taken by the ACP countries in the field of energy.

However, as much in Brussels as in the ACP countries, the idea of special emphasis on energy cooperation was gaining momentum: at Bremen, the heads of state and government of the Nine affirmed on 6 and 7 July 1978 the necessity of helping the LDC's cover their energy needs; some days later, in Bonn, the western economic summit adopted an equivalent position, which enabled the World Bank to launch a very major program of loans for oil activities in the oil-importing LDC's. The European Commission worked strenously to prepare an "energy plank" in the new Lome II Convention.

This progress is largely reflected in the text of the new convention: the subject of energy is mentioned this time in 12 articles, and one of them (article 76) is entirely devoted to energy cooperation. Lome II makes several innovations, by specifying the types of activities to develop and the necessary resources available. Thus, one of the most important innovations lies in the possibility, for the EIB, of going into its own resources, outside the totals scheduled by the convention, for energy projects of mutual benefit to the EEC and the country concerned (article 59).

Among the aspects of energy cooperation to be carried out are the establishment of energy inventories concerning the enhancement of renewable energy, regional resources, unusual energy production sites as well as the installation near these sites of high energy consumption industries, the establishment of programs for rural energy, and regional cooperation, that is, cooperation among ACP countries.

To this day, not all the resources made available through Lome I (4th Eruopean Development Fund) have yet been exhausted, but enough elements exist to put together a clear picture of the efforts made in the field of energy. By terms of the Lome principle, every project was to have been established and presented by the ACP beneficiary state, and brought to completion European assistance. Over the course of the 4 years Lome I, 48 projects were completed or are still to be completed. They are of vastly different scale--going from the solar water-heater at a cost of 5,000 EEC accounting units (to Niger) to the Kpong dam (Ghana which represents a total investment of 213.1 million EEC accounting units.

The projects fall into 4 categories: hydro-electricity (74 percent of European grants), thermal power (5 percent), transport networks (14 percent), and alternative energies (7 percent). These figures reflect a certain judgement on the part of Europe: in effect, 93 percent of the financing went to electrification programs, and 7 percent to renewable energy projects.

It is worth noting that Europe systematically avoids supporting the oil sector. This [is done] not only in order not to increase the dependence of the ACP's on oil, but also to take into account the fact that the companies which invest in this field do not have financial problems at present.

The EEC has poured out, in all these projects, close to 190 million EEC accounting units (113 in grants and loans from the FED, 77 in loans from the EIB). Now the total cost of these projects amounted to 910 EEC accounting units. In reality, the Community's financial support, though modest, has a very big psychological impact on other lenders of international funds. In such a way that the European capital has attracted more, through a "snowball" effect, by a factor of more than 4 to 1.

In the second Convention, which is opening this year, energy should play an even more decisive role than ever: out of the 15 ACP states which have already programmed the utilization of Community aid, 10 envisage investing in energy projects (explorations or infrastructure) between 2.5 and 15 percent of the European "envelope."

The North-South Dialog: A Turning Point in World Energy Cooperation?

Whatever be the exemplary value of the energy cooperation spelled out in the Lome Convention, it is obvious that it is inadequate, in view of the needs: the African country, an agricultural producer, sees its export earnings entirely eaten up by its oil bill, which prevents it from investing in its development. Other less developed ACP countries, landlocked or insular, experience an even more pathetic situation...Worldwide, the oil bill for the LDC's is presently reaching $80 billion, against $35 billion 2 years ago!

Besides, aid to the LDC's in the field of energy cannot come only from Europe, nor even from just the industrialized countries: the OPEC countries also have a role to play, and all these activities must be coordinated to maximize their effectiveness.

Finally, energy cooperation does not only mean helping the non-oil-producing LDC's, but also satisfying the needs of all groups of countries. At this level, the western countries are also the supplicants vis-a-vis the members of OPEC: for continuity and guaranteed supplies. The OPEC countries, for their part, are supplicants for guarantees as to the maintenance of the value of their export earnings, and for aid in building their economies in preparation for the post-oil era.

It is in this context of all demands that the North-South dialog will open in New York next November. It will take up the negotiations begun in Paris in 1975 and 1977, on the initiative of President Giscard d'Estaing.

From appearances, these first encounters between the industrialized and developing countries ended in sharp defeat, at least concerning energy. Their representatives were unable to come to a mutual understanding except on general principles, such as the recognition of the exhaustible character of fossil resources, or the necessity of economizing energy, and remained in disagreement on all joint initiatives in the realm of prices, aid to non-producing LDC's, export earnings, etc.

In reality, the results of the first two North-South meetings were less negative than they seemed, for the joint statement was relatively sophisticated and correct when it affirmed the necessity for the world community (the term used in the final report) to move to other sources of energy, and to reserve hydrocarbons for "their non-energy, non-substitutable uses." If the Dialog did not yield results in 1975 and 1977, it is perhaps because the delegations present were animated by a spirit of solidarity within their respective northern and southern groups, and of intransigence with respect to the other. Since then, there has been some growth in maturity. For example, the United States no longer believes it must break OPEC, which, on its side, is no longer so assured of the solidarity of the other LDC's. These latter are less and less supportive of OPEC's price policy, which victimizes them the most.

Thus, this "group solidarity" of countries seems to be giving way to a consciousness of the equal effect of the energy problem on all countries, and of the necessity for all to make concessions. Countries and organizations are preparing thus to face the music. In France, for example, President Giscard d'Estaing did not fail to allude, in a speech made in Lyon last March, to the need for the country "to prepare itself to render considerable aid to the Third World."

The LDC's have already expressed themselves several times in the same way, through the words of Mr Portillo, the president of Mexico, and through those of the Indian delegation. Their proposals are quite close to those of the United Nations, as expressed by secretary general K. Waldheim. They consist, in part, in adopting an international development strategy (IDS), of an all-encompassing character (like the Lome Convention), in which would be integrated a global plan to rationalize energy. A system regulating oil availability and prices would be established on a world scale. Mr Portillo proposes, further, the setting up of a world energy fund (designed to aid the LDC's to equip themselves or, in the case of the most impoverished, to pay their oil bill, the creation of a bank of energy technologies as well as an international energy institute.

The Nine have already reached a fairly precise position on the subjects which should be discussed at the meeting in New York: the "energy" chapter

should be of high priority and should involve, within the framework of the IDS, the non-oil-producing LDC's, who would be helped:

--to plan for their medium-term energy demands,

--to conserve their energy,

--to develop their own energy resources, in order that their rate of energy growth should be higher than the growth rate for their economies.

The Commission would also like to discuss possibilities of improving the investment climate in the LDC's, where private involvement has been stagnant at a very low level for years, due to fear of non-economic risks.

The discussions with the OPEC countries promise to be bitter; the goal will be to come to common rules that will introduce some predictability into oil increases and to negotiate supply guarantees in exchange for agreements on self-limitation by the consuming countries. Another very sensitive point would be the progressive transfer of the petrochemical industry from Europe to the producing countries...

Must we expect the conclusion of spectucular agreements of this nature to issue from the third Dialog? We do not believe so. The reflexes of rejection or entrenchment in positions are still very much alive, and most of the programs presented are more in the nature of principles than of instruments of world change, immediately operational. But the North-South dialog could also conclude with an affirmation by all participants of their determination to work together to achieve a world energy balance satisfactory to all, and with the setting up of a permanent working group of the different groups of countries: in this case, the next meeting in New York would be a true turning point in world energy cooperation.

The Lome Convention and the ACP Countries

The Lome Convention established economic links between the Europe of the Nine and 59 countries of Africa, the Caribbean, and the Pacific (AC), 57 of whom are former colonies. Its principles are based on relations of equality between the blocs, as economic partners, and on "non-directive" European aid (that is to say, the ACP's use it as they deem appropriate) not requiring counterpart funds. The final goal of Lome is achieve an inter-dependence of rich and poor countries, in the case at hand, of Europe and Africa. But its uniqueness lies in the rather extensive gamut of instruments of cooperation, which makes of Lome a veritable "development laboratory" on a global scale.

Among these are:

--Grants or loans coming from the European Development Fund (FED) and the European Investment Bank (EIBO) totalling 5.23 billion EEC accounting units

(or nearly 30.5 billion French Fr.) over the next 4 years. They will make possible the financing of development projects (industrial infrastructure, agricultural, schools, hospitals, roads, etc.). They will also feed a very curious system of "insurance" of exports of raw materials ("Stabex" system) and of mining products ("Sysmin").

--An almost total opening of European borders to the products of the Convention.

--A special sugar protocol by which the Community promises to buy 1.3 million tons of sugar at the European price (3 times greater than the world price). The EEC already having a surplus of sugar must re-export a good portion of these purchases on the world market and at the world price.

The first Lome I Convention covered the period from 1976-1979; the second opens this year and will cover the period 1980-1984.

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SCIENCE POLICY

REPORT OUTLINES GOVERNMENT ENERGY RESEARCH POLICY

Paris AFP SCIENCES in French 3 Jul 80 pp 2-4

[Article: "Government Energy Research Policy"]

[Text] A Ministry of Industry report on the "French Course of Action" in energy matters reveals that research and development funds allotted to energy research amounted to 2.524 billion francs in 1979, 63 percent of which was earmarked for energy generated by nuclear fission.

The changing pattern of these funds reflect both the steady decrease in the percentage allotted to nuclear fission research, from 74 percent in 1976 to 63 percent in 1979, and the sustained 1 percent per year increase in funds earmarked for research on new energy sources, particularly solar energy, which reached 10 percent in 1979.

The report lists the following five priority areas of research activity:

a. Rational use of energy: the methods to be used in an effort to obtain gains of 20 percent include heat pumps, new insulation techniques, more efficient automobiles, and such "horizontal" problems on storage of energy and more efficient heat energy (calories).

b. New methods of exploring for hydrocarbons: oil-exploration techniques in difficult areas, enhanced oil recovery (to raise recovery rate from 25 percent to 40 percent by the year 2000), and improved geophysical techniques (5 billion francs will be allotted to the overall prospecting effort by 1985).

c. Use of coal: fluidized-bed combustion, use of fuel oil-coal suspension, and more efficient coal gas generators.

d. Nuclear energy: research must center on two priority objectives, namely complete mastery of the technology of pressurized water reactors in anticipation of the expiration in 1982 of licensing agreements (four-party program: CEA [Atomic Energy Commission], FRAMATOME [Franco-American Atomic Engineering Company], EDF [French Electric Power Company], and Westinghouse),

and development of fast reactors. Research in connection with construction of the Super Phenix reactor must center on the objective of increasing the breeding ratio while reducing costs and improving equipment reliability.

e. New or alternate energy sources: allot to COMES [expansion unknown] financial resources commensurate with its assigned objectives, and assign priority to the development of biomass technology and home solar heating (joint CEA and CNRS [National Center for Scientific Research] research and development of new materials and more efficient storage system).

The following more problematic and more costly long-range areas of research activity have also been defined:

a. Process heat reactors for the "heat market": the Thermos program for development of low-temperature reactors designed for urban heating (100 megawatts), with construction of two such units scheduled to begin in 1980; at the other extreme, high-temperature reactors (fluids at 800° centigrade) designed for such industrial applications as prereduction in the iron and steel industry, production of hydrogen in the petrochemical industry, and coal gasification. But because of their limited potential use, these high-temperature reactors must not be a priority area of research activity.

b. Thermonuclear fusion: without having priority in the French nuclear program, public funds allotted to fusion research in 1979 amounted to approximately 120 million francs, or 5 percent of the energy research budget. On the European Community level, the Joint European Torus (JET) installed by Euratom is expected to permit the following long-term developments: demonstration in the 1980 decade, construction of a pilot reactor in the 2000 decade, and regular production of commercial fusion reactors by the year 2010.

c. Coal gasification: two new methods other than the so-called "autothermal" method which uses one part of coal as fuel: nuclear gasification, a difficult process from both a technical and financial standpoint; and underground gasification at great depth inside the coal seams, but this method's chances of success are difficult to determine.

d. Hydrogen: production of hydrogen from nuclear energy (thermochemistry) or hydrocarbons, through coal gasification by electrolysis (thermodissociation) of water, one of the most promising processes. There are great long-range possibilities for the use of hydrogen in industrial applications, in transportation (supersonic transport aircraft in particular), and in the home for which its feasibility has already been established. By the year 2,000, hydrogen could represent 5 to 10 percent of total energy consumption.

e. High-temperature--150° to 300°--geothermal energy: this process can be used for direct production of electricity. The geothermal power station at Bouillante, Guadeloupe, the first 6-megawatt plant, is scheduled to become operational in 1981.

FRENCH ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION BUDGET

(in millions of current francs)

Purpose	1976	%	1977	%	1978	%	1979	%
Nuclear fission	1,297	74	1,495	71	1,463	65	1,597	63
Fusion	77	4	98	5	110	5	121	5
Fossil fuels	83	5	130	6	218	10	236	9
New Energy Sources	116	7	161	8	217	9	251	10
Energy conversion, storage, transfer, and conservation techniques	176	10	210	10	256	11	314	12
Miscellaneous	3		4		4		5	
TOTAL	1,752		2,098		2,268		2,524	

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